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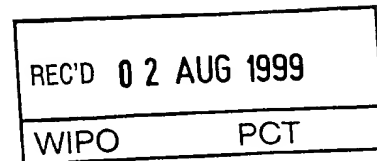
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This is to certify the correctness of the following information:

The attached photocopy is a true copy of the following document:

- The specification, claims and abstract as filed with the application on the filing date indicated above.



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TAASTRUP 22 June 1999

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DK2557237003

**Process for the Preparation of Ammonia**

GB-164.DQC

The present invention is directed to the preparation of ammonia by catalytic conversion of an ammonia synthesis gas.

Conventionally, industrial ammonia synthesis is based on conversion of ammonia synthesis gas consisting of hydrogen and nitrogen in a substantially stoichiometric mole ratio of 3:1. The synthesis gas is passed at high pressure through a fixed bed of ammonia catalyst particles of mainly magnetite, which is converted by reduction into the catalytically active form of  $\alpha$ -iron.

The process performance is governed not only by the catalyst composition, but also by the size and shape of the catalyst particles. For ammonia synthesis processes operating at catalyst beds with an axial synthesis gas flow the usual catalyst particle size is in the range of 6-10 mm.

Due to a reduced flow resistance in radial flow type ammonia reactors the catalyst particle size employed in these reactors is between 1.5 and 3 mm.

It has now been found that process performance of ammonia synthesis still may be improved in terms of a higher ammonia product yield when employing in radial ammonia reactors a fixed catalyst bed of ammonia catalyst comprising catalyst particles with a size below 1.5 mm.

Pursuant to the above finding, this invention is a process for the preparation of ammonia by contacting an ammonia synthesis gas with ammonia catalyst particles arranged in a fixed bed, wherein the fixed bed comprises catalyst particles of the ammonia catalyst with a particle size being in the range of <1.5 mm and 0.2.

By decreasing the size of the catalyst particles, the bulk density increases causing a higher pressure drop over the catalyst bed, and, thereby, an improved flow distribution of the synthesis gas within the bed.

When operating the inventive process at industrial conditions an improved flow distribution of synthesis gas is obtained when the catalyst bed contains at least 10% by volume of ammonia catalyst particles having a particle size below 1.5 mm.

The Table below summarizes the relative density of different particle sizes of conventional ammonia catalysts [KM?, reduced ?] commercially available from Haldor Topsøe A/S.

Table

Particle Size/mm	$\rho$ rel.
1.5-3.00	1.00
0.8-1.5	0.97
0.3-0.8	0.95

At present a preferred particle size of ammonia catalyst arranged as fixed bed is obtained by mixing particles with a size of 1.5-3.0 mm, 0.8-1.5 mm, and 0.3-0.8 in a volume ratio of 40-70 : 10-40 : 10-30.

**CLAIMS**

1. Process for the preparation of ammonia by contact-  
ing an ammonia synthesis gas with ammonia catalyst par-  
5 ticles arranged in a fixed bed, wherein the fixed bed  
comprises catalyst particles of the ammonia catalyst with a  
particle size being in the range of <1.5 mm and 0.2.
2. The process of claim 1, wherein the fixed bed  
10 contains at least 10% by volume of catalyst particles  
having a particle size in the range of <1.5 mm and 0.2 mm.
3. The process of claim 1, wherein the fixed bed  
contains a mixture of particles with a size of 1.5-3.0 mm,  
15 0.8-1.5 mm and 0.3-0.8 mm in a volume ratio of 40-70 : 10-  
40 : 10-30.
4. The process according to anyone of the preceding  
claims, wherein the synthesis gas is passed in radial  
20 direction through the fixed bed.

# **ABSTRACT**

Process for the preparation of ammonia by contacting an ammonia synthesis gas with ammonia catalyst particles arranged in a fixed bed, wherein the fixed bed comprises catalyst particles of the ammonia catalyst with a particle size being in the range of  $<1.5$  mm and  $0.2$ .